User Manual

SUNNY DESIGN 3 and SUNNY DESIGN WEB

Legal Provisions

The information contained in this document is the property of SMA Solar Technology AG. Publishing its content, either partially or in full, requires the written permission of SMA Solar Technology AG. Any internal company copying of the document for the purposes of evaluating the product or its correct implementation is allowed and does not require permission.

Trademarks

All trademarks are recognized, even if not explicitly identified as such. A lack of identification does not mean that a product or symbol is not trademarked.

The BLUETOOTH® word mark and logos are registered trademarks owned by Bluetooth SIG, Inc. and any use of these marks by SMA Solar Technology AG is under license.

Modbus® is a registered trademark of Schneider Electric and is licensed by the Modbus Organization, Inc.

QR Code is a registered trademark of DENSO WAVE INCORPORATED.

Phillips® and Pozidriv® are registered trademarks of Phillips Screw Company.

Torx® is a registered trademark of Acument Global Technologies, Inc.

Copyright

"Sunny Design" software has been developed by SMA Solar Technology AG and is copyright protected. It is provided to the user free of charge and for an unlimited period.

Inverter Data

The employed technical data of the SMA inverter is continuously checked and, if necessary, adapted. Nevertheless, deviations and errors cannot be excluded. We accept no responsibility for the completeness and/or correctness of the data (The data does not represent guaranteed characteristics).

PV Module Data

The employed technical data of the PV modules is based on the publicly accessible information of the respective manufacturers. SMA has integrated the available data into the software with the greatest care possible. The contents of this software are continuously checked and, if necessary, adapted. Nevertheless, deviations cannot be excluded. We cannot accept responsibility that the data is up-to-date, correct and complete as it is subject to frequent modifications.

Insulation Data

This data have been given to SMA by several institutions and are allowed to be used in this program. Therefore, SMA does not take any liability for completeness and/or correctness of these data.

Warranty and Liability

The software is made available to the user free of charge, thus SMA cannot accept responsibility for its proper operation, for its suitability for certain purposes and for the non-violation of any rights of third parties. The software is used at the user's risk and responsibility. SMA is only liable in case of wrongful intent and gross negligence. In particular, SMA does not accept further liability for defects and consequential damage, for incorrect profit calculations or for loss of profits, loss of use, damage to used hardware, for loss of data, interruption of operation or other damage.

SMA Solar Technology AG
Sonnenallee 1
34266 Niestetal
Germany

Tel. +49 561 9522-0
Fax +49 561 9522-100
www.SMA.de
E-mail: info@SMA.de

© 2004 to 2014 SMA Solar Technology AG. All rights reserved.

Table of Contents

1 Information on this Document 5

2 Product Description 7

2.1 Sunny Design 7

2.2 Functions 7

2.3 System Requirements 8

3 Installation 9

3.1 Installing Sunny Design Desktop Version 9

3.2 Registering for Sunny Design 9

4 User Interface 10

4.1 Personal Homepage After Login 10

4.2 Project Pages 11

4.3 Project Tree 12

5 Creating a Project 13

5.1 Project Types 13

5.2 Creating a PV Project 14

5.3 Creating a PV Project with Self-Consumption 14

5.4 Creating a PV Hybrid Project 14

6 Operation 15

6.1 Starting Sunny Design and Selecting the Required Project Type 15

6.2 Entering Project Data 15

6.3 Defining the Load Profile 16

6.4 Configuring the Gensets 17

6.5 Configuring the PV System 17

6.6 Wire Sizing (Optional) 19

6.7 Determining Self-Consumption (Optional) 20

6.8 Plan System Monitoring (Optional) 21

6.9 Analyzing Efficiency (Optional) 23

6.9.1 Analyzing Efficiency (PV Project with and without Self-Consumption) 23

6.9.2 Analyzing Efficiency (PV Hybrid Project) 23

6.10 Overview of Results 23

6.11 Creating the Project Documentation 24

6.12 Changing the Password for Sunny Design/Sunny Portal 24

6.13 Forgot Password? 24

6.14 Have Design Suggestions Displayed 25

6.15 Setting Criterion for Sorting the Design Suggestions 26

6.16 Setting the Method for Calculating Design Suggestions 26

6.17 Changing the Share of the Inverter Costs 26

6.18 Creating Your Own Load Profile 26

6.18.1 Importing Consumption Data 27

6.18.2 Importing Consumption Data from Sunny Portal 28

6.18.3 Creating Consumption Data 28

6.19 Deleting Own Load Profile 29

6.20 Importing Data from Sunny Design Desktop Version from Software Version 2 29
6.21 Synchronizing Sunny Design Desktop Version and Sunny Design Web 30
6.22 Performing an Update for Sunny Design Desktop Version. 30
6.23 Entering Prices for PV Modules 30
6.24 Entering Prices for Inverters 31
6.25 Setting Own Currency 31
6.26 Displaying Deactivated Messages Again 31
6.27 Exiting Sunny Design 31
7 Glossary 32

1 Information on this Document

Validity

This document is valid for the desktop version "Sunny Design 3" from software version 3.20 and for the online version "Sunny Design Web" from software version 3.20.

Target Group

This document is intended for PV system designers. PV system designers must have the following qualifications:

- Knowledge of how an inverter works and is operated
- Knowledge of all applicable standards and directives

Additional Information

Links to additional information can be found at www.SMA-Solar.com. The documents are not necessarily available in all languages:

Document title	Document type
Performance Ratio	Technical Information
Designing PV Systems Optimized for Efficiency	Technical Information
Leading Leakage currents – Information on the design of transformerless inverters of type Sunny Boy/ Sunny Mini Central / Sunny Tripower	Technical Information
Grid connection – Influence of the Grid Conditions in Terms of Connected Power of PV Inverters	Technical Information
Reverse current – Advice on PV Array Configuration for PV Systems using Sunny Mini Central	Technical Information
Module Technology – SMA Inverters Provide the Optimum Solution for Every Module	Technical Information
Auslegung von PV-Anlagen im Polystring-Betrieb – Eigenverbrauchsoptimierung vs. Mismatch-Verlust (Design of PV systems in polystring operation – Increased self-consumption vs. mismatch loss)	Article
SMA Systemlösungen zur VDE-Anwendungsregel und dem EEG 2012 (SMA system solutions for the VDE application guide and the Renewable Energy Sources Act (EEG) 2012)	Advertising material

Symbols

Symbol	Explanation
i	Information that is important for a specific topic or goal, but is not safety-relevant
☐	Indicates a requirement for meeting a specific goal
☑	Desired result
✖	A problem that might occur

Typographies

Typography	Use	Example
bold	• Display texts • Elements on a user interface • Elements to be selected • Elements to be entered	• The value can be found in the field **Energy**. • Select **Settings**. • Enter the value **10** in the field **Minutes**.
>	• Connects several elements to be selected	• Select **Settings > Date**.
[**Button/Key**]	• Button or key to be selected or pressed	• Select [**Next**].

Nomenclature

In this document the designation "Sunny Design" is used when both Sunny Design versions are referred to (Sunny Design desktop version and Sunny Design Web).

2 Product Description

2.1 Sunny Design

Sunny Design is a software for planning and designing PV systems and PV hybrid systems. Sunny Design provides you with a design recommendation for your planned PV system or your planned PV hybrid system. Sunny Design also proposes a combination of PV array(s) and inverter(s) which meet, as closely as possible, your requirements regarding power class, energy yield and efficiency.

In addition, you have the option of determining and optimizing your potential self-consumption, sizing the cables, evaluating efficiency and, in PV hybrid systems, configuring gensets.

Difference Between Sunny Design Web and Sunny Design Desktop Version

Sunny Design is available as an online version "Sunny Design Web" and as a desktop version "Sunny Design 3". The range of functions of both versions is identical. You can only use Sunny Design Web via the Internet. You must install the desktop version of Sunny Design on your computer and, after initial registration, you do not need an Internet connection. To ensure that your Sunny Design desktop version remains current, (e.g. new inverters, new PV modules), you should occasionally perform an update for the Sunny Design desktop version via the Internet (see Section 6.22 "Performing an Update for Sunny Design Desktop Version", page 30). Sunny Design Web is always up-to-date.

You can synchronize Sunny Design Web and the Sunny Design desktop version via the Internet. This means that your Sunny Design projects are available in the Internet in Sunny Design Web and on your computer in the Sunny Design desktop version. For synchronization, you must have an Internet connection.

Sunny Design Web: registration required for full range of functions

To use the full range of functions of Sunny Design Web, you must register.

Sunny Design Desktop version: registration required and usable by one user per computer

To use the Sunny Design desktop version, you must first register for Sunny Design Web.

The Sunny Design desktop version can only be used by one user per computer. After initial login to the Sunny Design desktop version on the computer, the Sunny Design desktop version can only be used by this user on this computer.

2.2 Functions

Using Sunny Design, and in compliance with all current legal and industrial requirements, you can plan various design scenarios with all SMA inverters in the form of projects. In Sunny Design the following project types are available:

- PV project: for planning a PV system
- PV project with self-consumption: for planning a PV system with self-consumption
- PV hybrid project: for planning a PV system with electric generators

Depending on the selected project type, Sunny Design provides the following functions:

Function	PV project	PV project with self-consumption	PV hybrid project
Determine and optimize self-consumption		✓	
Determine the potential fuel savings and CO_2 savings			✓
Use predefined load profiles, import own consumption data, import consumption data from Sunny Portal, create own load profiles		✓	✓
Configure the gensets			✓
Wire sizing	✓	✓	✓
Plan PV system monitoring	✓	✓	✓
Analyze efficiency	✓	✓	✓
Enter prices for PV modules and inverters	✓	✓	✓

Function	PV project	PV project with self-consumption	PV hybrid project
Create personal locations using meteorological data from the Sunny Design database or imported meteorological data	✓	✓	✓
Create project templates with default values	✓	✓	✓
Print project documentation or save as PDF file	✓	✓	✓

2.3 System Requirements

Sunny Design Web

System requirements:

☐ A computer with Internet access must be available.

☐ A supported web browser must be installed on the computer.

☐ JavaScript must be activated in the web browser.

Supported web browsers:

The following web browsers are supported without restrictions:

- Microsoft Internet Explorer from version 9
- Mozilla Firefox from version 17
- Google Chrome from version 24
- Opera from version 12
- Apple Safari from version 6

Sunny Design Desktop Version

System requirements:

☐ A computer must be available.

☐ A supported web browser must be installed on the computer.

☐ JavaScript must be activated in the web browser.

☐ The computer must have at least 400 MB of free memory.

☐ The computer's main memory must be at least 2 GB.

Supported operating systems:

- Microsoft Windows XP from Service Pack 3
- Microsoft Windows 7
- Microsoft Windows 8

Supported web browsers:

- Microsoft Internet Explorer from version 8

3 Installation

3.1 Installing Sunny Design Desktop Version

In order to use Sunny Design Web, it is not necessary to install the Sunny Design desktop version.

Requirement:

☐ System requirements for the Sunny Design desktop version must be met (see Section 2.3).

Procedure:

„".NET Framework 4.0" is installed automatically if required

If .NET Framework 4.0 has not been installed on your computer, the Sunny Design installation file automatically installs it.

1. Download the Sunny Design desktop version to the computer from the download area at **www.SMA-Solar.com**.
2. Run the file **SDesign-x.xx.x.x_Internet-exe**.
   ☑ The **Sunny Design Setup** dialog box opens.
3. Confirm the security prompt if it appears.
4. Select the desired language.
5. Select [**OK**].
   ☑ The installation wizard opens.
6. Follow the instructions of the installation wizard.

3.2 Registering for Sunny Design

You must complete an initial one-time registration in order to use the Sunny Design desktop version and the full range of functions of Sunny Design Web. Upon registration, you are given an account which you can use for Sunny Design Web, the Sunny Design desktop version and Sunny Portal. If you are already registered for the Sunny Portal, you can use this account to log in to Sunny Design Web. You do not need to register again.

Procedure:

1. If you are using Sunny Design Web:
   - Start the web browser and call up **www.SunnyDesignWeb.com**.

   ☑ The Sunny Design Web homepage opens.
   - In the **Login** area, select the button [**Register for Sunny Design Web**].
2. If you are using the Sunny Design desktop version:
   - Select on the desktop by double-clicking or select Sunny Design from the list of installed programs.

   ☑ Sunny Design starts.
   - In the **Login** area, select the button [**Register for Sunny Design Web**].
3. Fill in the details on the user registration form.
4. Select [**Register user**].
   ☑ You receive a confirmation of registration by e-mail.
5. Open the e-mail and select the activation link.

☑ You are registered and your account is activated. You can log in to Sunny Design Web and to Sunny Design desktop version in the **Login** area using your account's e-mail address and password.

4 User Interface

4.1 Personal Homepage After Login

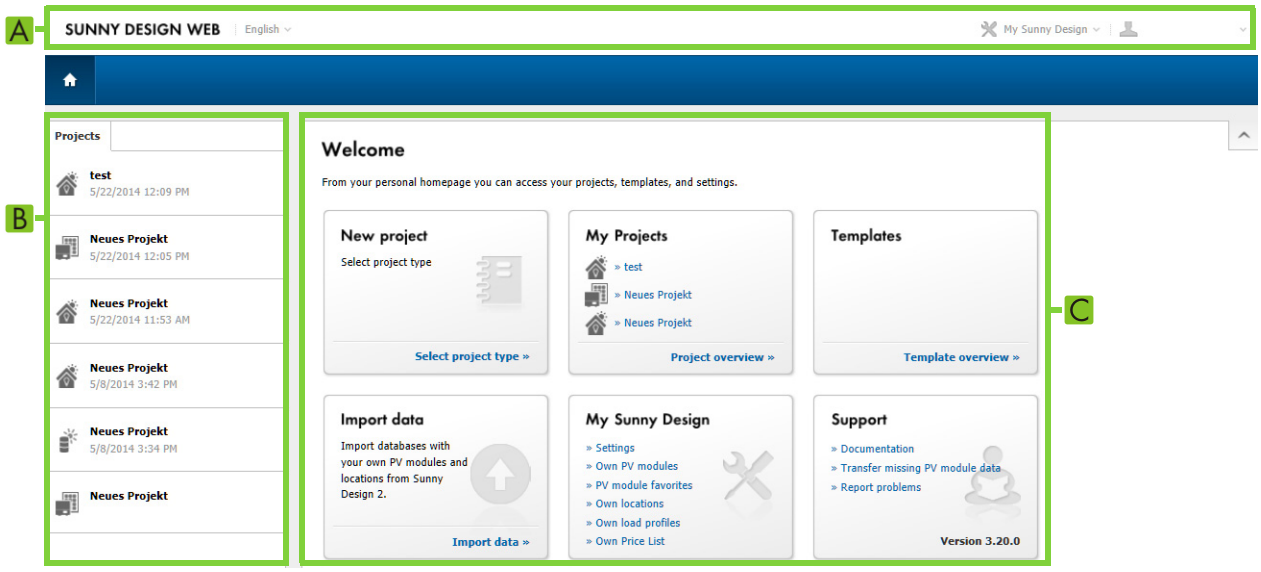

Figure 1: Personal homepage in Sunny Design Web after login (example)

Position	Designation	Explanation
A	Header	In the header, the following functions are available: • Language selection • For the Sunny Design desktop version: synchronization with Sunny Design Web • **My Sunny Design** menu: – Making settings for location specification, notification dialogs, units of measurement, temperature units – Making settings for calculation of design suggestions, for display of result values, for the letterhead on project documentation, for efficiency analysis and for tariff information – Creating own PV modules and favorites – Creating own locations – Creating own load profiles – Creating own price lists for inverters • Menu "**First name, last name**": – Changing the password – **Logout** (for the Sunny Design desktop version, you do not have to use the **Logout** button to log out. You can simply close the application window to exit Sunny Design.)
B	Navigation area	This area contains a list of the projects you have already planned.
C	Work area	In this area you have access to your projects, templates and settings. In the project overview, you can, for example, delete, rename, export, and duplicate projects and save them as templates.

4.2 Project Pages

The project pages are displayed after you have selected a project on the start page. You plan your project on the project pages.

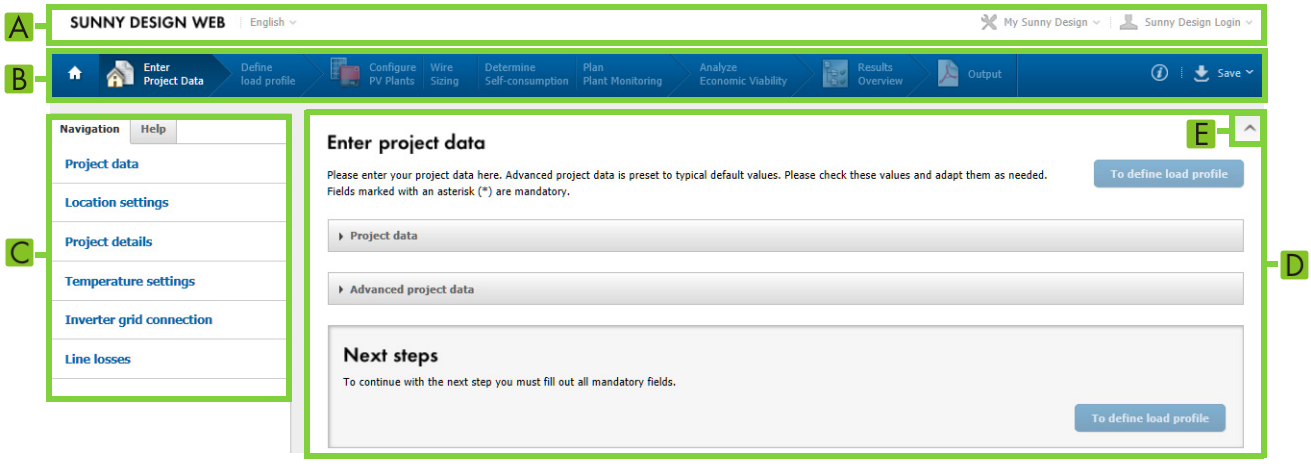

Figure 2: **Enter project data** project page (example)

Position	Designation	Explanation
A	Header	Explanation see table in Section 4.1
B	Main menu	Using this menu, you can call up the project planning pages that are displayed in the work area. The main menu maps the steps for planning a PV system or a PV hybrid system (see Section 5.1 "Project Types", page 13).
C	Navigation area	On small screens, the entire navigation area is automatically hidden and the › button is displayed. Using this button, you can then hide or display the entire navigation area. **Navigation** On the **Navigation** tab, hyperlinks are available for the settings on the page that is currently displayed. **Help** On the **Help** tab, you can call up help on the project page currently displayed. **Project tree** Explanation, see Section 4.3.
D	Work area	In this area, the content of the page currently selected in the main menu is displayed. Here you make settings and thus plan your project. **Next steps** At the end of each page in the work area, the next possible steps are displayed in the **Next steps** area. The buttons in this area can only be selected if you have made the necessary settings on the page.
E	-	Button to hide and display the header and the main menu

4.3 Project Tree

The project tree displays important project information, provides quick access to functions and enables navigation between the individual elements of the project.

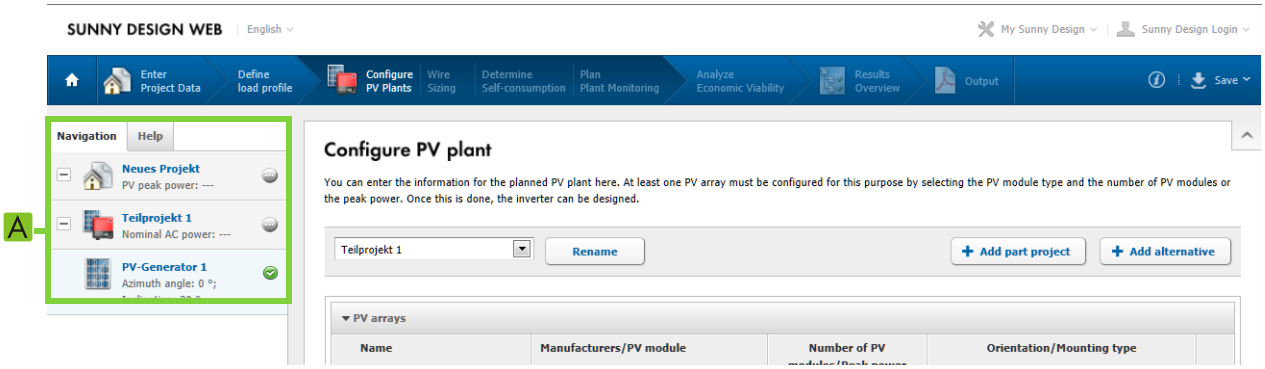

Figure 3: Project tree (example)

Position	Designation	Explanation
A	Navigation area	On the project page **Configure PV System**, the planned PV system is displayed in the navigation area in the form of a project tree.

Project Tree Symbols

Symbol	Designation	Explanation
	Project	A project is always present as the top element in a project tree.
	Subproject	Subprojects are elements of a project. There is always at least one subproject present in a project.
	PV array	PV arrays are elements of subprojects.
*	Inverter	Inverters are elements of subprojects. An inverter is assigned to one or more PV arrays, depending on whether it is a string inverter or a multi-string inverter.

* Example symbol; the relevant inverter is shown in each case.

Status Symbols of the Elements in the Project Tree

Symbol	Explanation
	Element in progress
	Element completed
	Observe information on element
	Error during element configuration - check element configuration.
	Warning - check element configuration.

Functions in the Project Tree

If you select an element in the project tree, a menu is displayed where you can rename, delete or duplicate the element, for example. You can also remove elements from a subproject or copy them to a different subproject.

5 Creating a Project

5.1 Project Types

In Sunny Design, you plan PV systems or PV hybrid systems in the form of projects.

- **PV project:** for planning a PV system
- **PV project with self-consumption:** for planning a PV system with self-consumption
- **PV hybrid project:** for planning a PV system with electric generators

Steps when Planning a PV System

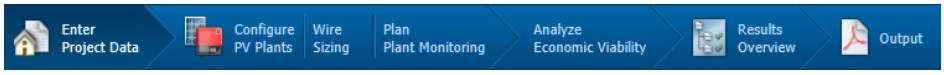

Figure 4: Main menu for PV projects*

Steps when Planning a PV System with Self-Consumption

Figure 5: Main menu for PV projects with self-consumption*

Aggregated menu options on small screens:

Main menu item	Submenu item
Additional options	Wire sizing
	Determine self-consumption
	Plan system monitoring

Steps for Planning a PV System with Electric Generators

Figure 6: Main menu for PV hybrid projects*

Aggregated menu options on small screens:

Main menu item	Submenu item
Define existing system	Define the load profile
	Configure the gensets
PV system	Configure PV system
	Wire sizing
Results	Results overview
	Project documentation

* On small screens, the symbols in the main menu are hidden and menu options are aggregated.

5.2 Creating a PV Project

Procedure		See
1.	Start Sunny Design and select the required project type	Section 6.1, page 15
2.	Enter the project data	Section 6.2, page 15
3.	Configure the PV system.	Section 6.5, page 17
4.	Wire sizing (optional)	Section 6.6, page 19
5.	Plan the system monitoring (optional).	Section 6.8, page 21
6.	Analyze efficiency (optional)	Section 6.9.1, page 23
7.	Overview of the results	Section 6.10, page 23
8.	Create the project documentation.	Section 6.11, page 24

5.3 Creating a PV Project with Self-Consumption

Procedure		See
1.	Start Sunny Design and select the required project type	Section 6.1, page 15
2.	Enter the project data	Section 6.2, page 15
3.	Define the load profile	Section 6.3, page 16
4.	Configure the PV system.	Section 6.5, page 17
5.	Wire sizing (optional)	Section 6.6, page 19
6.	Determine the self-consumption (optional).	Section 6.7, page 20
7.	Plan the system monitoring (optional).	Section 6.8, page 21
8.	Analyze efficiency (optional)	Section 6.9.1, page 23
9.	Overview of the results	Section 6.10, page 23
10.	Create the project documentation.	Section 6.11, page 24

5.4 Creating a PV Hybrid Project

Procedure		See
1.	Start Sunny Design and select the required project type	Section 6.1, page 15
2.	Enter the project data	Section 6.2, page 15
3.	Define the load profile	Section 6.3, page 16
4.	Configure the gensets	Section 6.4, page 17
5.	Configure the PV system.	Section 6.5, page 17
6.	Wire sizing (optional)	Section 6.6, page 19
7.	Analyze efficiency (optional)	Section 6.9.2, page 23
8.	Overview of the results	Section 6.10, page 23
9.	Create the project documentation.	Section 6.11, page 24

6 Operation

6.1 Starting Sunny Design and Selecting the Required Project Type

1. Start the Sunny Design desktop version on the computer or call up **www.SunnyDesignWeb.com**.
2. Log in with your user data.
3. Select [**New project**] on your personal start page.
4. Select the required project type.

☑ The page **Enter project data** opens (see Section 6.2, page 15).

6.2 Entering Project Data

Project Data Area

1. Enter the required project name in the field **Project name**.
2. In the **Location** area, select the desired location.
3. Select [**Low voltage**] or [**Medium voltage**].
4. If you have selected [**Low voltage**], select the required grid voltage in the **Grid voltage** drop-down list.
5. If you have selected [**Medium voltage**]:
   - Depending on which inverters you wish to use in the PV system, select either **Decentralized inverters** or **Central inverters** in the **System type** area.
   - If you have selected the option **Decentralized inverters**:
     - Enter the required medium voltage in the **Medium voltage** field.
     - In the **Inverter grid connection** drop-down list, select the required output voltage of the inverters.
     - If required, activate the checkbox **Carry out optimized reactive power adjustment with Integrated Plant Control**.
   - If you have selected the option **Central inverters**, enter the required medium voltage in the field **Medium voltage**.
6. If required, make additional settings in the **Advanced project data** area.

Advanced Project Data Area

In this area you can make further settings if required. There are some default settings in this area already in accordance with your settings in the **Project data** area.

1. In the required area, select [**Edit**].
   ☑ The settings dialog box opens.
2. Make the desired settings.

Next Steps Area

Project type	Next steps
PV system	• Select [**Configure the PV system**]. ☑ The page **Configure PV system** opens (see Section 6.5, page 17).
PV system with self-consumption PV hybrid project	• Select [**Define load profile**]. ☑ The page **Define load profile** opens (see Section 6.3, page 16).

6.3 Defining the Load Profile

You can select typical load profiles or create and edit your own load profiles. Tip: In the menu under **My Sunny Design > Own load profiles**, you can manage your own load profiles.

Load Profile Details Area

1. In the **Load profile type** area, select the required option. You can only select the option **Own load profile** if you have already created an own load profile (see Section 6.18).
2. In the **Load profile** drop-down list, select the required load profile. Tip: to call up information on the selected load profile, select [**Profile information**].
3. If required, adjust the setting in the field **Annual energy consumption**.
4. If you have selected the option **Own load profile**, you can edit the profile by selecting [**Edit load profile**].

Specific Loads Area

1. If you are using a heat pump, activate the checkbox **Heat pump** and, in the drop-down list, select the use of the heated water.
2. In the **Hot water requirement** area, enter the number of persons and the hot water requirement.
3. In the **Details of building** area, enter the type of building, the number of floors and the surface area of each floor.
4. To call up information on the load profile with heat pump, select [**Profile information**]. The button can only be selected if the **Heat pump** checkbox is activated.

Next Steps Area

Project type	Next steps
PV system with self-consumption	• Select [**Configure the PV system**]. ☑ The page **Configure PV system** opens (see Section 6.5, page 17).
PV hybrid project	• Select [**Configure gensets**]. ☑ The page **Gensets** opens (see Section 6.4, page 17).

6.4 Configuring the Gensets

Gensets Area

1. To adjust the parameters of a genset, select any field in the row of the required genset.
   ☑ The **Genset** dialog box opens.
2. If required, change the name of the genset in the **Name** field.
3. In the **Fuel** drop-down list, select the fuel for the genset.
4. If required, change the other settings for the genset.
5. Select [**Accept changes**].
6. To add additional gensets, select [**+ Add genset**].
7. To delete a genset, select in the row of the genset to be deleted. One genset remains permanently present, it cannot be deleted.
8. In the **Details** area, check whether the gensets can provide sufficient power for the load profile previously selected.

Design Conditions Area

- In the field **Load-related minimum power**, enter the minimum power that the gensets are to make available to the loads. You should also take account of the power reserve.
- In the field **Minimum PV power to be expected**, enter the minimum PV power to be expected for the PV system location.

Next Steps Area

- Select [**Configure the PV system**].

☑ The page **Configure PV system** opens (see Section 6.5, page 17).

6.5 Configuring the PV System

The settings on the page **Configure PV system** always refer to the currently selected subproject. A subproject consists of at least one PV array and at least one inverter per PV array. You can add alternatives for each subproject, for example, to compare alternative designs.

PV Arrays Area

1. To change the name of the subproject, select [**Rename**] and enter the desired name.
2. Make the following settings in the row of the PV array:
   - Select the field **Manufacturers/PV module** and select the required PV module. Tip: To use the search, select .
   - To call up information on the selected PV module, select .
   - Select the field **Number of PV modules/Peak power** and determine the size of the PV array using the number of PV modules or the peak power.
   - Select the field **Orientation/Mounting type** and select the required properties.
3. To add an additional PV array:
   - Select [**+Add PV array**]. The settings of the existing PV array are copied automatically.
   - If required, change the settings of the added PV array. Tip: you can change the settings for all PV arrays at the same time by activating the checkbox **Change all PV arrays** in the relevant dialog box for entering changes.
4. To delete a PV array, select in the row of the PV array. One PV array is always present and cannot be deleted.

Inverter Design Area

In this area, you select suitable inverters for the PV arrays in the current subproject.

1. To select inverters manually:
   - Select [**Manual design**].

   ☑ The dialog box **Select an inverter** opens.
   - To restrict the list of displayed inverters, activate the required checkboxes in the **Set inverter limits** area.
   - In the area **Additional inverters**, select the row of the required inverter.

   ☑ The selected row is displayed in a different color.
   - Select [**Apply inverter**].

   ☑ The selected inverter is added to the subproject and displayed in the **Inverter** area.
   - To add further inverters, select [**Manual design**].
2. To select inverters from design suggestions, see Section 6.14.
3. To have the inverters selected automatically by Sunny Design:
   - To restrict the selection of inverters, select [**Inverter filter**] and activate the required checkboxes.
   - Select [**Automatic design**].

   ☑ The **Design** dialog box opens.
   - If required, change the displacement power factor and the method for calculating design suggestions.
   - Select [**Accept changes**].

   ☑ The proposed inverters are added to the subproject and displayed in the **Inverters** area.

Inverter Area

1. If notes are displayed, observe the notes and solution suggestions.
2. If required, check the design in the **Details** area.
3. To delete an inverter, select in the row of the inverter.

Next Steps Area

Project type	Next steps
PV system	• To skip optional steps, select [**Results overview**] (see Section 6.10, page 23).
PV system with self-consumption	• To carry out optional steps, select [**Wire sizing**] (see Section 6.6, page 19).
PV hybrid project	

6.6 Wire Sizing (Optional)

Overview Area

1. If the PV system is to have a subdistribution, activate the checkbox **Project subdistribution available (LV3)**. The **Graphic** area is adjusted and the **AC2 cables** tab is added.
2. If an MV transformer is to be present in the PV system, activate the checkbox **Medium-voltage line and MV transformer available (MV)**. The **Graphic** area is adjusted and the **MV transformer** tab is added.

Configuration Area

The diagram shows the cable routes in the PV system:

- **DC** indicates the cables from the inverter to the first PV module in the string.
- **LV1** indicates the cables from the inverter to a possible subdistribution in the subproject or directly to the feed-in point.
- **LV2** indicates the cables from a possible subdistribution in the subproject to the subdistribution of the total project.
- **LV3** indicates the cables from the possible subdistributions to the possible MV transformer.
- **Transformer / MV** indicates the cables from a possible MV transformer or from a possible subdistribution to the feed-in point.

The Tabs DC cables, Cables LV1, Cables LV2, Cables LV3, MV Transformer

1. To take account of the line losses in the yield forecast, choose **Enter project data** in the main menu and, in the area **Advanced project data** > **Line losses**, select the button [**Edit**] and activate the checkbox **DC** or **AC**.
2. Select the tab of the required cable.
3. Select the required fields in the column **Cable material**, **Single length** and **Cross-section** and make the required settings. The values for **Current**, **Voltage**, **Voltage drop** and **Rel. power loss** are calculated automatically.

Next Steps Area

Project type	Next steps
PV system	• Select [**Plan system monitoring**]. ☑ The page **Plan system monitoring** opens (see Section 6.8, page 21).
PV system with self-consumption	• Select [**Determine self-consumption**]. ☑ The page **Determine self-consumption** opens (see Section 6.7, page 20).
PV hybrid project	• Select [**Efficiency analysis**]. ☑ The page Efficiency **analysis** opens (see Section 6.9, page 23).

6.7 Determining Self-Consumption (Optional)

Increased Self-Consumption Area

In this area, you can select devices for increasing self-consumption.

1. To change the selection of devices, select [**Devices filter**] and activate the required checkboxes.
2. For increased self-consumption with the Sunny Home Manager, activate the checkbox **Management of loads with radio-controlled sockets**.
3. For increased self-consumption with systems for intermediate storage of energy:
   - Activate the checkbox **Temporary storage of surplus solar power.**
   - In the **Device** column, select the required device.
   - Select the **Settings** field in the row of the required device and configure the storage.
4. For increased self-consumption with specific loads:
   - Activate the **Specific loads** checkbox. The checkbox is already activated if you have selected a heat pump as a load on the page **Define load profile**. If required, you can adjust the settings here.
   - In the **Device** column, select the required device.
   - Select the **Settings** field in the row of the required device and enter the properties.

Result Area

In this area, the increased self-consumption details are displayed graphically.

Load and Load Profile Analysis Area

This area is displayed if you have selected an imported load profile on the **Define load profile** page.

- To open the load analysis for the imported load profile, select [**Open load profile**].

Next Steps Area

Project type	Next steps
PV system with self-consumption	• Select [**Plan system monitoring**]. ☑ The page **Plan system monitoring** opens (see Section 6.7, page 20).

6.8 Plan System Monitoring (Optional)

Specifications area

1. Depending on the requirements that you have of the PV system monitoring, activate the required checkboxes:

Requirement	Explanation
Optimizing self-consumption	You wish to obtain action recommendations for manual switching of loads in order to make optimal use of own PV energy on site (self-consumption).
Analysis of consumption and management of loads	You wish to obtain an analysis of your consumption. You also wish to have automatic intelligent switching of loads in order to make optimal use of own PV energy on site.
PV system monitoring via the Internet and visualization of PV system data	You wish to monitor the PV system via the Internet and visualize the PV system data in the Internet.
Online archiving	You wish to archive the PV system data in the Internet.
Remote diagnosis	Yo wish to analyze PV system faults via the Internet.
Visualization of PV system data on site	You wish to view the PV system data on site.
Plant maintenance and parameterization on site	You wish to enable maintenance and parameterization of the PV system on site.
Storage of PV system data on site	You wish to store the PV system data on site.
Connecting external sensors	You wish to connect sensors from third-party manufacturers to the PV system (e.g. wind sensor, ambient temperature sensor)
Measuring global radiation	You wish to measure the global radiation.
Reading out energy meters	You wish to read out the data of the feed-in meter, the PV production meter and the purchased electricity meter.
Feed-in management	You wish to or must participate in feed-in management with the PV system. In accordance with the Renewable Energy Sources Act (EEG) 2012, PV system operators with installed power of 30 kW to 100 kW must participate in feed-in management (variable active power limitation). PV system operators with installed power less than 30 kW have a choice: they can participate in feed-in management or they can limit the active power of their PV system to 70 % (fixed active power limitation).
Control of large-scale PV power plants	You wish to control and regulate your large-scale PV power plant (connection to a SCADA system).
Wireless data transmission	You would like to wirelessly call-up the PV system data.
Notification in case of disturbances	You wish to be notified if disturbances occur in the PV system.

2. Depending on the requirements on your PV system, activate the required checkboxes:

Requirements	Explanation
Internet access is available	The PV system can be connected to the Internet.
Own operation control system is available	A control room (SCADA system) is available.
S0 meter interface is available	An S0 meter interface is available in the PV system.
D0 meter interface is available	A D0 meter interface is available in the PV system.

Design Area

In this area, you select the communication products for PV system monitoring.

1. In order to only use current (not discontinued) communication products in the design, activate the checkbox **Only take current communication products into account**.
2. You have the following options for selecting the communication products:
   - To have the communication products selected automatically, select [**Automatic design**].
   - To select communication products from proposals, select [**Design alternatives**] and then select [**Adopt design**] in the the column of the required design alternative.
   - To select a specific communication product for PV system monitoring, select [**Add communication product**]. If you have activated the checkbox **Only take current communication products into account**, you can only select current communication products in the list.
3. To remove all added communication products from the **Result** area, select [**Delete system monitoring**].

Result Area

In this area, you obtain an overview of the internal and external communication products used in the project and the type of data transmission.

- If a communication product is to be included in the design alternatives, select the lock symbol next to the communication product. The lock symbol is displayed closed. To undo the setting, select the lock symbol again.
- To delete a communication product, select [**X**] next to the communication product.

Next Steps Area

Project type	Next steps
PV system	• Select [**Efficiency analysis**].
PV system with self-consumption	☑ The page Efficiency **analysis** opens (see Section 6.9.1, page 23).

6.9 Analyzing Efficiency (Optional)

6.9.1 Analyzing Efficiency (PV Project with and without Self-Consumption)

Cost Structure Area

In this area, you can enter details on the PV system costs, financing, electricity purchase costs and the feed-in tariff. No price management is available for PV system monitoring products. You can make default settings for the cost structure in the menu **My Sunny Design > Settings > Efficiency** and **"My Sunny Design > Settings > Tariff information**.

Procedure:

- To change the cost structure details for the current project, select [**Edit**] in the relevant area.

Results Area

- To change the view of the first diagram, select [**Savings**] or [**Cumulative savings**].

Next Steps Area

- Select [**Results overview**].

☑ The **Overview** page opens (see Section 6.10, page 23).

6.9.2 Analyzing Efficiency (PV Hybrid Project)

Efficiency Area

In this area, the results of the efficiency analysis are displayed.

Cash Flow Area

- To change the view of the first diagram, select [**Nominal cash flow**] or [**Discounted cash flow**]. The type of cash flow has an effect on the expected amortization period in the Efficiency area.

Next Steps Area

- Select [**Results overview**].

☑ The **Overview** page opens (see Section 6.10, page 23).

6.10 Overview of Results

Information Area

This area is displayed if information on the design is available.

- Note the information and adjust the design.

Results Area

- Select the required tab to view the results for the PV system or for performance.
- To save the values from this area as a CSV file, select [**Export**].

Next Steps Area

- Select [**Project documentation**].

☑ The **Create project documentation** page opens (see Section 6.11, page 24).

6.11 Creating the Project Documentation

Sunny Design saves the project documentation as a PDF file. To display PDF documents, you need the Adobe Reader software. You can download Adobe Reader for free on the Internet.

Settings Area

1. In the **Documents** area, activate the checkboxes that are to be contained in the project documentation.
2. If you have saved design alternatives on the **Configure PV system** page, you can choose between the original design and the design alternatives by selecting **Select** and activating the required design.
3. In the area **Paper size**, select the desired paper format.
4. Select [**Download project documentation**].

Preview Area

- To scroll through the project documentation preview, select [**<**] or [**>**].

Next Steps Area

- To open your personal start page of Sunny Design, select [**To personal homepage**].

6.12 Changing the Password for Sunny Design/Sunny Portal

You can change your Sunny Design password in Sunny Design. Your Sunny Design password is also your Sunny Portal password.

1. Start the Sunny Design desktop version or log in to Sunny Design Web.
2. In the header menu, select **First name, last name > Change password**.
   ☑ The **Change password** dialog box opens.
3. Fill out the fields.
4. Select [**OK**].

6.13 Forgot Password?

1. Start the Sunny Design desktop version or call up **www.SunnyDesignWeb.com**.
2. In the header, select **First name, last name > Change password**.
   ☑ The **Change password** dialog box opens.
3. Select **Forgot password** and follow the instructions.

6.14 Have Design Suggestions Displayed

Requirements:

☐ You must have opened a project and have it planned up to page **Configure PV system**.

☐ You must have set the required PV arrays on the page **Configure PV system**.

Procedure:

1. On the page **Configure PV system**, in the **Inverter design** area, select the button [**Design suggestions**].
   ☑ The **Design** dialog box opens.
2. If required, adjust the settings in the **Design** dialog box and select [**Accept changes**].
   ☑ The **Design suggestions** dialog box opens.
3. To restrict the selection of inverters:
   - Select the **Set inverter limits** area and activate the required checkboxes.
   - Select the **Select an inverter** area and activate the required checkboxes.
   - Select [**Recalculate**].
4. To change the criterion for sorting the design suggestions, select the required sorting in the **Sorting** drop-down list (see Section 6.15).
5. To compare design suggestions:
   - In the **Selection** column, activate the checkboxes of the design suggestions to be compared.
   - Select [**Compare selection**].

   ☑ The **Compare suggested designs** dialog box opens.
   - To adopt a design suggestion, select [**Adopt design**] in the column of the required design suggestion.
   - To save a design suggestion as an alternative design, select [**Apply as alternative**] in the column of the required design suggestion.

   ☑ Above the area **PV arrays**, the **Original** tab is added and also a numbered **Alternative** tab for each design suggestion. In addition, the button [**Compare alternatives**] is added to the right of the tabs.
6. To add a design suggestion as an alternative design, activate the checkboxes of the required design suggestions in the **Selection** column and select [**Add selection as an alternative**].
   ☑ Above the area **PV arrays**, the **Original** tab is added and also a numbered **Alternative** tab for each design suggestion. In addition, the button [**Compare alternatives**] is added to the right of the tabs.
7. To adopt a design suggestion, activate the checkbox of the required design suggestion in the **Selection** column and select [**Adopt design**].

☑ The selected design is displayed in the **Inverter** area.

6.15 Setting Criterion for Sorting the Design Suggestions

You can select a criterion in Sunny Design to form the basis for the evaluation and sorting of design options.

The following criteria are possible:

- **Energy yield** (energetic optimum)
- Efficiency (consideration of the nominal power ratio and the inverter share of capital expenditure)

Requirements:

☐ You must have opened a project and have planned the project up to page **Configure PV system**.

☐ You must have set the required PV arrays on the page **Configure PV system**.

Procedure:

1. On the page **Configure PV system**, in the **Inverter design** area, select the button [**Design suggestions**].
2. Make the required settings in the **Design** dialog box.
3. Select [**Accept changes**].
4. In the **Design suggestions** dialog box, select the required criterion in the **Sorting** drop-down list. The more a design suggestion corresponds to a criterion, the higher up the list it is displayed.

6.16 Setting the Method for Calculating Design Suggestions

You can change the default setting for the method for calculating design suggestions. The setting is adopted for new projects and for the project that is currently opened.

1. In the header, select **My Sunny Design > Settings**.
   ☑ The **Settings** dialog box opens.
2. Select [**Design**].
3. In the area **Calculating and assessing suggested designs**, in the drop-down list **Method for calculating suggested designs**, select the required method.
4. Select .

☑ The **Settings** dialog box closes and the settings are adopted.

6.17 Changing the Share of the Inverter Costs

1. In the header, select **My Sunny Design > Settings**.
2. Select [**Design**].
3. In the area **Calculating and assessing suggested designs**, in the field **Share of the inverters on the investment costs**, select the required portion of the total investment costs that the inverter costs are to make up. The portion can be between 0% and 20%.
4. Select .

☑ The **Settings** dialog box closes and the settings are adopted.

6.18 Creating Your Own Load Profile

You have the following options to create your own load profiles:

- Importing consumption data
- Importing consumption data from Sunny Portal
- Creating consumption data

6.18.1 Importing Consumption Data

Requirements for the consumption data:

- ☐ The data series begins on January 1 at 00:00 a.m.
- ☐ The values cover a complete year (365 days or a leap year with 366 days).
- ☐ The values have a time interval of 5, 10, 15, 30 or 60 minutes.
- ☐ The power or energy values are positive and indicated in the following units: W, kW, Wh or kWh.
- ☐ All values are in the first column.
- ☐ Either a period (.) or a comma (,) is used as decimal separator.
- ☐ The data is in CSV format (.csv).

Example:

An excerpt from a CSV file containing data of one year (365 days) with a time interval of 15 minutes.

	A	B
1	86,8934325	
2	78,152673	
3	70,5687788	
4	64,1417497	
5	59,3857482	
6	56,0436931	
7	53,8585033	
8	52,4445569	
9	51,5447728	
10	50,9020699	
35038	117,361203	
35039	107,342563	
35040	97,4540363	
35041		
35042		

Procedure:

1. On the page **Define load profile**, select the button [**+New load profile**].

   or

   Select **My Sunny Design > Own load profiles > [Add new load profile]**.
2. In the field **Name**, enter a name for the load profile.
3. If required, enter a description for the load profile in the field **Description**.
4. If not yet active, select [**Import consumption data**].
5. In the area **Import consumption data**, select the form of the consumption data to be imported:
   - Select the number of days in the year in the **Number of days** drop-down list.
   - Select the time interval of the values in minutes in the **Time interval** drop-down list.
   - Select the unit in the **Unit** drop-down list.
   - Select [**Import consumption data**].
6. Select the file with the consumption data to be imported.
7. Select [**Open**].

   ☑ The message confirming that the import was successful is displayed. The calculated energy consumption per year is automatically displayed in the field **Default "Energy consumption per year"**.

   ✖ The message confirming that the import failed is displayed.
   - Select [**Details**] and take note of the message.
   - If the number of data points is not consistent, check the settings for **Number of days** and **Time interval** and change these so that the expected number of data points corresponds to the number of data points found in the file.
   - If the consumption data in the file is not in the first column or if there is data in the other columns, open a spreadsheet program (e.g. Excel), copy the consumption data series, insert it into a new document in the first column, and save as a CSV file.
8. If required, change the annual energy consumption in the field **Default "Energy consumption per year"**.
9. Select [**Save load profile**].

6.18.2 Importing Consumption Data from Sunny Portal

You can import consumption data from a PV system in Sunny Portal if you have access to a PV system in Sunny Portal using the e-mail address with which you log into Sunny Design.

1. On the page **Define load profile**, select the button [**+New load profile**].
   ☑ The **New load profile** dialog box opens.
2. In the field **Name**, enter a name for the load profile.
3. If required, enter a description for the load profile in the field **Description**.
4. Enter the annual energy consumption in the field **Default "Energy consumption per year"**.
5. Select [**Consumption data from Sunny Portal**].
6. In the **Sunny Portal system** drop-down list, select the required Sunny Portal system.
7. In the **Time period** drop-down list, select the time period from which the data is to be imported. You can chose whether the last twelve months (365 days retroactively from the previous day at 12 p.m.) are to be imported or the entire previous calendar year from January to December.
8. Select [**Import consumption data**].
   ☑ The message confirming that the import was successful is displayed. The calculated energy consumption per year is automatically displayed in the field **Default "Energy consumption per year"**.
   ✖ The message confirming that the import failed is displayed.
   It is possible that no consumption data or insufficient data is available for the selected Sunny Portal system.
   - In the **Sunny Portal system** drop-down list, select a different Sunny Portal system and select [**Import consumption data**].
9. If required, change the annual energy consumption in the field **Default "Energy consumption per year"**.
10. Select [**Save load profile**].

6.18.3 Creating Consumption Data

1. On the page **Define load profile**, select the button [**+New load profile**].
   or
   Select **My Sunny Design > Own load profiles > [Add new load profile]**.
2. In the field **Name**, enter a name for the load profile.
3. If required, enter a description for the load profile in the field **Description**.
4. Enter the annual energy consumption in the field **Default "Energy consumption per year"**.
5. Select [**Create consumption data**].
6. If required, adjust the seasons in the area **Breakdown of seasons into months**. To do this, select the dates for the beginning and end of summer and winter.
7. Create the required number of daily load profiles and assign to the different seasons.
8. Select [**Save load profile**].

6.19 Deleting Own Load Profile

Requirement:

☐ The load profile to be deleted must not be in use in any current projects.

Procedure:

1. Select **My Sunny Design > Own load profiles**.
   ☑ The **New load profile** dialog box opens.
2. Select the load profile to be deleted.
3. Select [**Delete**] and confirm the security prompt with [**Yes**].

6.20 Importing Data from Sunny Design Desktop Version from Software Version 2

You can import projects, PV modules and own locations from the Sunny Design desktop version from software version 2 into the Sunny Design desktop version from software version 3. Own locations and own PV modules are automatically designated with a * symbol in Sunny Design.

Importing Personal Databases from Sunny Design Desktop Version from Software Version 2

Database file requirements:

☐ The database file must not have been imported yet.

☐ The database file must be available in the following file formats:

- Projects in file format ".sdp2" or ".sdp3". You can first import projects in older file formats in Sunny Design 2 and save them in file format ".sdp2".
- Own PV modules and own locations in file format ".sdupd"

☐ The country of the location to be imported must be available in the country list.

Procedure:

1. In the **Import data** area of the personal homepage, select the button [**Import data**].
   ☑ The **Import data** dialog box opens.
2. Select the desired file format.
3. Select [**Import data**].
   ☑ The file selection window opens.
4. Select the desired database file and select [**Open**].

☑ Data of the selected database file is imported and information on the number of imported data sets is displayed. If the database already has an own PV module with the same name as the own PV module to be imported, Sunny Design adds a sequential number to the file name of the PV module that has been imported.

Example: importing a PV module

You would like to import your own PV module "My_PV module". An own PV module with this name already exists whose data is different to the data from the own PV module to be imported. Sunny Design imports the PV module and changes the file name to "My_PV module1".

✖ Data from the selected database file is not imported?

- Ensure that the requirements for the database file are met.

6.21 Synchronizing Sunny Design Desktop Version and Sunny Design Web

You can synchronize the Sunny Design desktop version with your account in Sunny Design Web. This means that your Sunny Design projects with all data and settings will be available both online and offline.

Requirements:

☐ The current software version of the Sunny Design desktop version must be installed on the computer (see Section 6.22).

☐ The computer must have an Internet connection.

Procedure:

1. Start the Sunny Design desktop version and log in with your own user data.
2. Select [**Synchronization**] in the header.
   ☑ The dialog box **Data synchronization** opens.
3. Select [**Start**].

☑ Sunny Design is performing the data synchronization. Sunny Design Web cannot be used during the synchronization.

6.22 Performing an Update for Sunny Design Desktop Version

Requirement:

☐ The computer must have an Internet connection.

Procedure:

1. Start the Sunny Design desktop version.
2. In the menu bar select **File > Online update**.

☑ The dialog box **Online update** opens and the online update is performed automatically.

6.23 Entering Prices for PV Modules

You can enter prices for PV modules. If you use a PV module with a price in the project, the price of the PV module is adopted as the default setting for the analysis of efficiency.

Requirement:

☐ You must have opened a project and have it planned up to page **Configure PV system**.

Procedure:

1. On the page **Configure PV system**, select .
   ☑ The **Find PV modules** dialog box opens.
2. Select the desired PV module.
3. Select **Edit price** and make the required settings.
4. Select [**Accept changes**].
   ☑ A query is displayed asking if you wish to adopt the price as the default setting.
5. Reply as applicable.

6.24 Entering Prices for Inverters

You can enter prices for inverters. If you use an inverter in the project, the price of the inverter is adopted as the default setting for the analysis of efficiency.

1. Select **My Sunny Design > Own price list** in the header.
   ☑ The **Own price list** dialog box opens.
2. To restrict the selection of inverters:
   - Select the **Set inverter limits** area and activate the required checkboxes.
   - Select the **Select an inverter** area and activate the required checkboxes.
   - Select [**Recalculate**].
3. Select the required inverter and enter the required price.

6.25 Setting Own Currency

1. In the header, select **My Sunny Design > Settings**.
2. Enter the required currency in the field **Own currency**.
3. Select .

☑ The **Settings** dialog box closes and the settings are adopted.

6.26 Displaying Deactivated Messages Again

If you have activated the checkbox **Do not display this message again** in a dialog box in Sunny Design Web, you can undo this setting again.

Requirement:

☐ Messages must be deactivated.

Procedure:

1. In the header, select **My Sunny Design > Settings**.
2. Select [**General**].
3. In the **Information dialog** area, select the button [**Display deactivated messages again**].
4. Select .

☑ The **Settings** dialog box closes and the settings are adopted.

6.27 Exiting Sunny Design

- In Sunny Design desktop version, close the application window. Logging out is not necessary.
- For Sunny Design Web, select [**Logout**] in the header and close the web browser.

☑ This exits Sunny Design.

7 Glossary

AC

Abbreviation for "Alternating Current".

Annual Energy Yield

The annual energy yield is the electrical energy that the PV system can typically feed into the utility grid in one year.

Central Inverter

Inverter concept in which all PV modules are connected to each other (in series or parallel) and a single inverter is used for feeding power into the external utility grid.

DC

Abbreviation for "Direct Current".

Displacement Power Factor cos φ

The AC current of a reactive-power capable inverter is phase-shifted compared to the grid voltage. The larger this line conductor angle or phase shift angle between power and voltage is, the more reactive power is fed into the utility grid. By multiplying the cosine function of the line conductor angle or phase shift angle with the apparent power (= voltage x current), you can easily calculate the remaining active power. This is why the value of cos φ is also called displacement power factor.

Energy Usability Factor

The energy usability factor indicates which proportion of the electrical energy supplied by the PV array can be used by the inverter and converted to alternating current. The energy usability factor is not 100% if the inverter cannot process the entire PV array current in every operating situation due to current, voltage or output limits. For economic reasons, an energy usability factor of 99.8% is desirable.

Genset

Electric generator with a combustion engine (e.g. diesel, gas or petrol).

Independent Inputs

Each independent input of an inverter has its own MPP tracker. The operating point of the connected PV array can therefore be set independently of the operating points of PV arrays connected to other independent inputs. Multi-string inverters have at least two independent inputs.

Inverter

A device for converting the direct current (DC) supplied by the PV array into alternating current (AC), which is necessary for connection of most devices and especially for feeding solar energy into an existing transmission line. Inverters for PV systems usually contain one or more MPP trackers, store operating data, and monitor the grid connection of the PV system.

Inverter Efficiency

The inverter efficiency is the average inverter efficiency during a typical operating year.

The inverter efficiency can be simply put using the following formula:

Formula for calculation of inverter efficiency

$$\text{Inverter efficiency} = \frac{\text{Annual energy yield}}{\text{Annual utilization of electrical energy of the PV array}}$$

Maximum DC Current

The inverter can only process input currents below a certain upper limit. However, this upper limit is not relevant when designing and operating a PV system, since the inverter completely controls its DC input.

Maximum DC Power

The maximum DC power is the maximum power the inverter can process. This limiting value strongly depends on the input voltage and the ambient conditions.

Maximum DC Voltage

The inverter is designed for operation below a maximum DC voltage. If the limiting value for the DC voltage is exceeded, parts of the inverter may be damaged. Therefore, when designing a PV system, the maximum DC voltage is particularly important when it comes to feed-in interruptions at low PV cell temperatures.

Maximum Power Point (MPP)

The operating point (current/voltage characteristic curve) of a PV array where the maximum power can be drawn. The actual MPP changes constantly depending, for example, on the level of solar irradiation and the temperature.

Maximum PV Array Current

When operating a PV system, the maximum PV array current is generated if the PV modules are operated at the maximum power point (MPP) and the cell temperature of the PV modules is very high. If necessary, the inverter limits the PV array current to the maximum DC current. In this case, the inverter cannot set the MPP. This will only rarely lead to reduced yields, though, since the peak power of the PV array is already limited due to the inverter being undersized.

Maximum PV Short-Circuit Current

See maximum short-circuit current.

Maximum PV Voltage

The maximum PV voltage occurs if the PV cells are very cold and the PV array is in no-load operation. A common design point for maximum PV voltage is therefore the open-circuit voltage at a PV cell temperature of –10°C.

Maximum Short-Circuit Current

It can make sense in certain situations to short-circuit the PV array to protect the PV modules or the inverter. SMA inverters with Optiprotect offer this option. However, the PV array can only be short-circuited if the short-circuit current resulting from the short-circuit does not exceed a certain maximum value. The PV system must therefore be designed in such a manner that the short-circuit current of the connected PV array does not exceed the maximum short-circuit current of the inverter inputs.

Minimum DC Voltage

The minimum DC voltage must exceed a minimum value in order for the inverter to feed into the utility grid. Depending on the inverter working principle, the minimum DC voltage is either preset or varies with the current grid voltage. When designing a PV system, the minimum DC voltage for operation at high PV cell temperatures and for the time at which the inverters start feed-in in the morning must be observed.

Minimum PV Voltage

When operating a PV system, the minimum PV voltage only occurs if the cell temperature of the PV modules is high and the PV modules are operated at their maximum power point (MPP). Therefore, the MPP voltage at a cell temperature of +70°C is a common design point for minimum PV voltage.

MPP Tracker

Readjustment of the power drawn so that a PV array is operated for as long as possible at the maximum power point (MPP). This operating point varies with the solar irradiation and the temperature conditions of the PV modules. MPP tracking optimizes the extraction of electrical power and is a feature of inverters and charge controllers.

Multi-String Inverter

An inverter which, to a great extent, combines the advantages of several string inverters (separate MPP tracking of individual strings) and a central inverter (low power-specific costs).

Nominal Power Ratio

The nominal power ratio indicates how high the maximum DC power of the inverter is compared to the peak power of the PV array. In Central Europe, for example, the inverters in most PV systems are slightly undersized so that the nominal power ratio is less than 100%.

The nominal power ratio is represented by the following formula:

Formula for calculating the nominal power ratio

$$\text{Nominal power ratio} = \frac{\text{Maximum DC power of the inverter}}{\text{Peak power of the PV array}}$$

With Sunny Design, the recommended lower limit of the nominal power ratio is calculated specific to the system. The lower limit mainly depends on the location, the type and the orientation of the PV arrays as well as their circuitry with the inverters. For a given configuration of the PV array(s) with an inverter, an individual lower limit is calculated. This corresponds to an energy usability factor of 99.8%. Thus, PV arrays with an orientation that is not optimal, e.g. east/west or facade systems, can be designed with optimal inverter dimensioning. If the lower limit defined for the location, e.g. 90% for Central Europe, is below the calculated limit, the defined lower limit is used.

Peak Power

The peak power of a PV module is the electrical power supplied by the PV module if operated under standard test conditions (STC) at the maximum power point (MPP). Peak power is also often called nominal power.

Performance Ratio

The performance ratio (PR) is the ratio between the nominal yield and the target yield of the PV system. It thus shows the proportion of the energy that is actually available for feed-in operation after deducting the energy losses (e.g. due to thermal losses and line losses) and the self-consumption. The closer the PR value determined for a PV system approaches 100%, the more efficiently this PV system is operating.

Polystring

Polystring operation is the parallel operation of two PV arrays with differing orientation that are of the same PV module type and have the same number of PV modules at a joint inverter input. This operating mode enables two PV arrays with differing orientation to be connected to just one MPP tracker.

Project

PV systems are created and edited in the form of projects in Sunny Design. The PV arrays and inverters in the PV system are created and edited as subprojects.

PV Array

Technical device for the conversion of solar energy into electrical energy. All series (= in series) and parallel installed and connected PV modules of a PV system are referred to as a PV array.

A PV array in Sunny Design is a field of interconnected PV modules that fulfills the following requirements:

- Same manufacturer
- Same PV module
- Same location
- Same mounting type
- Same orientation, that is, the same tilt angle and same azimuth

PV Cell

An electronic component that generates electrical energy when irradiated with sunlight. Since the electrical voltage of a single PV cell is very low (approximately 0.5 V), multiple PV cells are combined as PV modules. The most common semiconductor material presently used for PV cells is silicon, which is used in different forms (monocrystalline, polycrystalline, amorphous).

PV Module

Electrical connection of several PV cells encapsulated in an enclosure to protect the sensitive cells from mechanical stress and environmental influences.

Rated Power

The inverter rated power is the active power that the inverter can continuously feed into the utility grid under nominal conditions.

Reactive power

The value and prefix changes periodically with electrical alternating quantities (alternating current, alternating voltage). In the utility grid, current and voltage have a sinusoidal shape. The product of current and voltage is power. The power can, however, assume differing forms - depending on whether current and voltage are phase-shifted or not. Without a phase shift (current and voltage reach their maximum and minimum values at the same time), the power oscillates between zero and the positive maximum value. Over a temporal average period, this results in a positive power value which is exclusively active power. In the case of a phase-shift of 90 degrees or ¼ period (maximum current at zero voltage) the power, in contrast, assumes alternating positive and negative values. The temporal average is therefore zero, known as reactive power, which "shuttles back and forth" in the cables. Many loads need a phase shift between current and voltage so that reactive power always has to be transferred in the utility grid in addition to active power.

Self-Consumption

Power that your household draws from your PV system

Self-Consumption Quota

Ratio of self-consumption to generated energy of your PV system

Self-Sufficiency Quota

Ratio of self-consumption to total consumption

Specific Energy Yield

The specific energy yield is the amount of energy typically fed into the utility grid in a year in relation to the size (peak power) of the PV array. The result is shown in kWh/kWp and enables an initial estimate of whether the PV system is supplying an energy yield typical for the respective location. Since this value is also influenced by the structural characteristics of a PV system (e.g. orientation of the PV array), it is generally not suitable for comparing PV systems with one another.

STC (Standard Test Conditions)

In order to compare the power of different PV modules, standard test conditions (STC) are used:

- Global radiation 1,000 W/m²
- Temperature 25°C
- AM 1.5 (AM= Air Mass, a relative measurement for the path that light covers through the earth's atmosphere to the ground. The air mass at the equator is AM=1 and approximately 1.5 in Europe)

String

A group of electrical series-connected PV modules. Normally, a PV system is made up of multiple strings.

String Inverter

Decentralized inverter concept where the PV array is divided up into individual strings. The individual strings are connected to the utility grid through their own string inverters. This greatly simplifies installation and reduces the yield losses which can be caused by variations in production or variations in shading on the PV modules.

Subproject

In Sunny Design, a subproject is part of a planned PV system project and consists of up to three PV arrays and the associated inverters.

Typical PV Voltage

The typical PV voltage is the MPP voltage of a PV module whose cell temperature corresponds to the NOCT: Normal Operation Cell Temperature = cell temperature at irradiation of 800 W/m², ambient temperature of 20°C and a wind speed of 1.0 m/s. The NOCT is also often shown on the datasheet of the PV modules.

Unbalanced Load

The unbalanced load is the maximum power difference that may occur between any two line conductors of a PV system feeding into the multi-phase utility grid. In the planning phase of a PV system, this value refers to the distribution of nominal AC power from single-phase feed-in inverters to the three line conductors of the utility grid at the feed-in point.

SMA Solar Technology

www.SMA-Solar.com